UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/902,483	07/11/2001	Cyril Cabral JR.	YO999-408 CIP	7319

21254 7590 02/14/2002

MCGINN & GIBB, PLLC
8321 OLD COURTHOUSE ROAD
SUITE 200
VIENNA, VA 22182-3817

EXAMINER	
KIELIN, ERIK J	
ART UNIT	PAPER NUMBER
2813	# 9

DATE MAILED: 02/14/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/902,483	Applicant(s) CABRAL ET AL.	
	Examiner Erik Kielin	Art Unit 2813	

-- Th MAILING DATE of this communication app ars on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12 January 2002* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-22* is/are pending in the application.

4a) Of the above claim(s) *14-22* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-13* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *19 September 2001* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *5, 6* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of the invention of group I, claims 1-13 in Paper No. 8 is acknowledged.

Information Disclosure Statement

2. The listing of references in the specification is not a proper information disclosure statement. 37 CFR 1.98(b) requires a list of all patents, publications, or other information submitted for consideration by the Office, and MPEP § 609 A(1) states, "the list may not be incorporated into the specification but must be submitted in a separate paper." Therefore, unless the references have been cited by the examiner on form PTO-892, they have not been considered. See article reference cited on p. 6, lines 13-14 in the specification.

Drawings

3. Figures 1, 7A, 7B, and 8 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application.

4. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the method of silicide performed on "bulk silicon substrate" as required in claim 2, and the "TiN or W cap," as required in claim 7, must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

5. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference sign(s) not mentioned in the description: **All reference**

characters in the specification directed to Figs. 1 through 6 are **absent** from the newly submitted drawings filed 9/19/01, Paper No. 4, as was the case in the originally submitted drawings. The reference characters in the specification, but absent from the drawings, are too numerous to mention.

For all of the above objections, a proposed drawing correction, corrected drawings, or amendment to the specification to add the reference sign(s) in the description, are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

6. The disclosure is objected to because of the following informalities:

on p. 11, line 6, replace "fo" with --of-- for correct spelling;

on p. 12, line 17, remove "Application" and replace "09/515,033" with 6,323,130 to update status of application which is now a patent;

on p. 12, line 20, remove "having IBM Docket No. YOR900-0044;" and

on p. 18, line 5, replace "application Serial No. 09/515,033 with "U.S. Patent No. 6,323,130" to update application status.

Appropriate correction is required.

Claim Rejections - 35 USC § 112(1)

7. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

8. Claims 5 and 9 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for Co and Ti, does not reasonably provide enablement for Ni. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims.

Applicant's specification, at page 5, lines 11-12, states "The $NiSi_2$ phase has a higher resistivity than NiSi. Thus a second RTA is **not** applied in the case of [n]ickel." On page 17, lines 6-7, the specification states, "Then, a **first** rapid thermal anneal (RTA) is performed to form the CoSi, C49 $TiSi_2$, or **NiSi** phase." And in continuing states, on the same page at lines 21-22, "As mentioned earlier in the case of [n]ickel, the NiSi is [the] lower resistivity phase, and thus a **second** RTA is **not** used. (Emphasis added.)

First, since there is no desire to form a second phase of Ni silicide, as expressly indicated in the specification, it is, nonetheless, impossible to avoid its formation because, as presently claimed in claim 4, the step of "reacting the silicon cap layer to form a second silicide phase" is still required, in direct contradiction to claim 9 which requires the second RTA to be omitted, thereby preventing the second reaction step.

Second, in addition to the contradiction just noted, it defies common sense to deposit the silicon cap for the claimed, required purpose of forming a second silicide phase, since no second phase is desired to be formed from NiSi, as expressly indicated in the specification. The silicon cap is simply superfluous, since it is not going to be reacted with the NiSi anyway. Why then add the additional process steps and production costs required to deposit a silicon cap layer and then remove it, unchanged, when the purpose of the silicon cap layer is obviated in the case of Ni by

the creation of the desired NiSi phase in the *first* reaction step, as expressly indicated in the specification?

Accordingly, one of ordinary skill could not practice the invention, with Ni, using the two required reacting steps of claim 4 while contradictorily not performing the second RTA as required in claim 9.

Claim 5 indicates that the metal can be Co, Ti, or Ni and is therefore only enabled for Co and Ti.

Claim Rejections - 35 USC § 112(2)

9. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

10. Claims 8 and 9 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 8 is considered indefinite because it is unclear, as presently written, whether claim 8 requires the performing of additional steps to those in claim 4 or is merely further limiting those steps in claim 4. Read in light of the specification, it appears that the latter is the case. The rejection could be overcome by using language such as; "wherein said reacting the metal...to form the first silicide phase is performed by a first rapid thermal anneal." Such language makes clear that the steps in claim 4 are being further limited. Similar language should be used for each of the steps.

Claim 9 is indefinite for having all of the limitations of claim 8.

For the purposes of patentability, the claims will be read in light of the specification, wherein the steps in claim 4 are merely further limited by the steps is claim 8.

Claim Rejections - 35 USC § 102

11. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in-
> (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or
> (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

12. Claims **1**, 2, and **4**, 5, 8, 12, and **13** are rejected under 35 U.S.C. 102(e) as being anticipated by US 6,165,903 (**Besser** et al.).

Regarding independent claims 1, 4, and 13, **Besser** discloses a silicon substrate 30, which is bulk silicon as further limited in instant claim 2 (Fig. 4);

depositing a metal layer 42 which may be cobalt (Co) or titanium (Ti), as further limited in as in instant claim 5 (Fig. 5);

reacting the Co layer to form a first silicide phase layer (CoSi) 44, using RTA (rapid thermal annealing) as further limited in instant claim 8 (Fig. 6; col. 4, line 63 to col. 5, line 4);

selectively etching any unreacted Co while leaving behind the silicide 44 (Fig. 7; col. 5, lines 19-24);

depositing a silicon cap layer 46 (Fig. 8; col. 5, lines 25-28), without using epitaxial processes (col. 5, lines 36-40), as further limited in instant claim 12;

reacting the cap layer to form a second silicide phase layer ($CoSi_2$) 48 using RTA (Fig. 9, col. 5, lines 49-63), as further limited in instant claim 8; and

etching any unreacted silicon cap layer (Fig. 10; col. 6, lines 9-12).

(See also col. 4, line 38 to col. 6, line 24 for the entire process.)

13. Claims **1**, 3, and **13** are rejected under 35 U.S.C. 102(e) as being anticipated by Patent Application Publication US 2002/0009856 A1 (**Kanamori**).

Kanamori discloses a substrate having a silicon layer (an SOI, or silicon-on-insulator substrate, as further limited in instant claim 3) 112, 114, 116 (Figs. 2A); depositing a cobalt (Co) metal layer 126 (Fig. 2B) to a thickness of 5-12 nm (paragraph [0030]); depositing a TiN cap 128 on the Co layer; reacting the Co layer to form a first silicide (CoSi) 130, 132 using rapid thermal annealing (RTA) (Fig. 2C; paragraph [0031]); etching any unreacted Co and capping TiN (last sentence of paragraph [0031]); depositing a silicon cap layer (poly-Si) 136 (Fig. 2D) without using epitaxial processes (paragraph [0032]); reacting the cap layer to form a second silicide phase ($CoSi_2$) 138, 140 using RTA (paragraph [0033]) and etching any unreacted silicon cap layer (Fig. 2E; paragraph [0034], [0042]). (See also paragraphs [0028] through [0035].)

Note that the same process is shown for Ti metal with an amorphous silicon cap layer (a-Si) which is etched off after the second reacting (rapid thermal anneal, RTA) step. (See Figs. 3A-3E and associated paragraphs [0036] through [0043].)

Claim Rejections - 35 USC § 103

14. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

15. Claims 2, and 4-8, 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Kanamori** in view of **Besser**.

Regarding claims 2 and **4**, 5, the prior art of **Kanamori**, as explained above, teaches all of the features of the claims except for using a bulk silicon substrate. **Besser** teaches virtually the same method as in **Kanamori**, but the process is performed on a bulk silicon substrate, for the same purpose: to reduce silicon consumption during silicide formation thereby preventing the associated problems (**Kanamori**, paragraph [0027]; **Besser,** first sentence of Abstract). Accordingly, it would be an obvious matter of design choice to perform the method of **Kanamori** on a bulk silicon substrate, as **Besser** has taught, in order to reduce silicon consumption on bulk silicon substrates, as desired in **Besser**.

Regarding claim 6, as noted above, **Kanamori** discloses a Co layer thickness of 5-12 nm which is broader than the 7-8 nm range than presently claimed. However, it has been held that the selection of optimum ranges within prior art general conditions is obvious, in the absence of evidence of unexpected results relative to the prior art range. It would have been obvious to one of ordinary skill at the time of the invention to optimize the Co metal thickness range in **Kanamori** according to the thickness of the SOI layer used, in order to achieve the objective in **Kanamori** of reduced silicon consumption.

Regarding claim 7, as indicated above, the TiN cap layer is disclosed.

Regarding claim 8, as indicated above, the first and second RTA steps are disclosed.

Regarding claim 12, as indicated above, the polysilicon or amorphous silicon are deposited using CVD -- not epitaxial processes.

Allowable Subject Matter

16. Claims 10-11 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

17. The following is a statement of reasons for the indication of allowable subject matter: The prior art of record does not teach or suggest, in combination with the other method steps, co-depositing metal with silicon, instead of metal alone, as claimed in claim 10. Nor does the prior art of record indicate the claimed co-deposited ratio for Co and Si.

Conclusion

18. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

US 6,297,148 B1 (Besser et al.) discloses the instant invention except for removing the silicon capping layer after the second RTA. (See Figures and cols. 4-6.)

US 5,994,191 (Xiang et al.) anticipates most features of the instant invention with the notable exception of the indicated allowable subject matter. (See Figures and cols. 5-7.)

US 6,015,752 (Xiang et al.) teaches forming a Ni layer 20 and then depositing an amorphous silicon cap layer 30 on the nickel and then performing a single RTA to form NiSi, and then removing the excess silicon.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 703-306-5980. The examiner can normally be reached on 9:00 - 19:30 on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached at 703-306-2417. The fax phone numbers for the organization where this application or proceeding is assigned are 703-306-7722 for regular communications and 703-306-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-306-3431.

Erik Kielin
February 4, 2002